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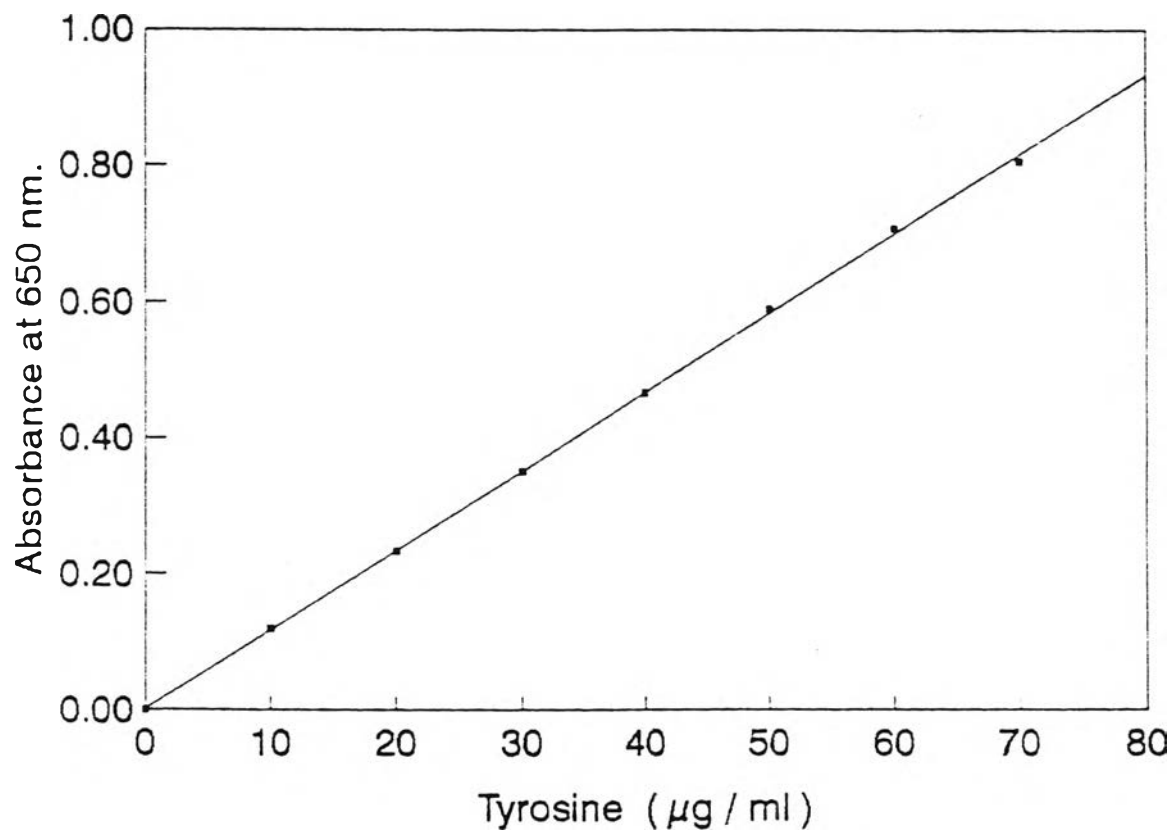
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APPENDIX



Appendix 1 Tyrosine standard graph for estimating polyphenol content by Folin and Ciocalteu reaction

Appendix 2 Comparison of total lipids, tocotrienols, carotenoids and polyphenols contents in the latex collected from different rubber clones

Composition (in 100 g dry wt. rubber)	Rubber clones		
	RRIM 600	GT 1	PB 5/51
Total lipids (g)	2.24	3.15	4.65
	1.54	2.97	2.63
	1.51	1.93	2.84
	2.19	0.80	1.26
Mean \pm S.D.	1.87 \pm 0.40	2.21 \pm 1.08	2.82 \pm 1.40
Tocotrienols (g)	0.07	0.08	0.06
	0.11	0.04	0.09
	0.08	0.07	0.06
	0.08	0.08	0.07
Mean \pm S.D.	0.08 \pm 0.02	0.07 \pm 0.02	0.07 \pm 0.01

Appendix 2 (continue)

Composition (in 100 g dry wt. rubber)	Rubber clones		
	RRIM 600	GT 1	PB 5/51
Carotenoids (μg)	63.1	82.3	127.5
	58.9	86.1	188.3
	65.1	126.1	181.8
	50.4	182.9	260.5
Mean \pm S.D.	59.6 \pm 6.5	119.3 \pm 46.7	189.5 \pm 54.6
Polyphenols (g)	0.15	0.05	0.06
	0.10	0.15	0.16
	0.14	0.14	0.16
	0.10	0.11	0.13
Mean \pm S.D.	0.12 \pm 0.02	0.11 \pm 0.04	0.13 \pm 0.05

Statistical analysis of variance of tocotrienols

SOURCE OF VARIATION	DF	SS	MS	F
AMONG GROUPS	2	6.938726E-04	3.469363E-04	1.447787
WITHIN GROUPS	9	2.15669E-03	2.396322E-04	
TOTAL	11	2.850562E-03		

TREATMENT	MEAN	STANDARD DEVIATION
RRIM 600	0.08	0.015
GT 1	0.07	0.013
PB 5/51	0.07	0.013

$F_{.95}$ - value from table at 2,9 df. is 4.26

accept $H_0 : \mu_1 = \mu_2 = \mu_3$

Statistical analysis of variance of carotenoids

SOURCE OF VARIATION	DF	SS	MS	F
AMONG GROUPS	2	33798.22	16899.11	9.736477
WITHIN GROUPS	9	15620.34	1735.649	
TOTAL	11	49419.06		

TREATMENT	MEAN	STANDARD DEVIATION
RRIM 600	59.65	6.524
GT 1	119.33	46.742
PB 5/51	189.51	54.585

$F_{.95}$ - value from table at 2,9 df. is 4.26

reject $H_0 : \mu_1 = \mu_2 = \mu_3$

t - VALUE FROM TABLE AT 9 df. IS 1.8331

TABLE OF NON-SIGNIFICANT (MEAN(i)=MEAN(j))		
DIFFERENT OF	DIFFERENT	LSD

There are significant difference in all clones tested.

Statistical analysis of variance of polyphenol

SOURCE OF VARIATION	DF	SS	MS	F
AMONG GROUPS	2	4.081875E-04	2.040938E-04	.1342772
WITHIN GROUPS	9	1.367949E-02	1.519943E-03	
TOTAL	11	1.408768E-02		

TREATMENT	MEAN	STANDARD DEVIATION
RRIM 500	0.12	0.023
GT 1	0.11	0.043
PB 5/51	0.13	0.047

$F_{.95}$ value from table at 2,9 df. is 4.26

accept $H_0 : \mu_1 = \mu_2 = \mu_3$

Appendix 3 Distribution of polyphenols oxidase activity in various fractions of fresh field latex

Latex clone	PPO activity in various fraction ($\times 10^3$ unit/100 g dry weight of rubber)			
	Rubber	Serum	Lutoid	Total
RRIM 600	0	110.8	27.1	137.9
	0	188.0	33.3	221.3
	0	54.3	6.0	60.3
	16.2	120.7	7.0	143.9
Mean \pm S.D.	4.0 \pm 8.0	118.4 \pm 54.8	18.4 \pm 13.9	140.8 \pm 65.8
GT 1	19.0	194.8	35.9	249.7
	0	111.5	23.2	134.7
	5.2	185.3	34.9	225.5
	3.9	244.6	59.1	307.7
Mean \pm S.D.	7.0 \pm 8.2	184.0 \pm 54.9	38.3 \pm 15.0	229.7 \pm 71.9

Appendix 3 (Continue)

Latex clone	PPO activity in various fraction ($\times 10^3$ unit/100 g dry weight of rubber)			
	Rubber	Serum	Lutoid	Total
PB 5/51	0	301.6	82.9	384.6
	9.8	89.7	21.0	120.5
	8.5	182.9	269.8	461.3
	20.0	72.7	11.7	104.4
Mean \pm S.D.	9.6 \pm 8.2	161.7 \pm 105.0	103.1 \pm 133.0	267.7 \pm 182.0

Statistical analysis of variance of total
polyphenol oxidase activity from 3 rubber clones

SOURCE OF VARIATION	DF	SS	MS	F
AMONG GROUPS	2	3.3369423+10	1.6684723+10	1.191159
WITHIN GROUPS	9	1.279532+11	1.42173+10	
TOTAL	11	1.6132243+11		

TREATMENT	MEAN	STANDARD DEVIATION
BBIM 500	4149240.00	465770.164
BB 1	4029402.75	471347.319
BB 5.51	4097593.75	478970.134

$F_{.35}$ - value from table at 2,9 df. is 4.26

accept $H_0 : \mu_1 = \mu_2 = \mu_3$

Statistical analysis of variance of polyphenol oxidase
in various fraction of rubber clone RRIM 600

SOURCE OF VARIATION	DF	SS	MS	F
BETWEEN GROUPS	2	3.1076362E+10	1.5538181E+10	14.27181
WITHIN GROUPS	9	9.7985993E+09	1.0887333E+09	
TOTAL	11	4.0862355E+10		

TREATMENT	MEAN	STANDARD DEVIATION
RUBBER	34003.75	33077.500
SEED	31044.75	35494.000
LEAF	31035.50	33087.000

$F_{.95}$ - value from table at 2,9 df. is 4.26

reject $H_0 : \mu_1 = \mu_2 = \mu_3$

F - VALUE FROM TABLE AT 2 DF. IS 1.4301

TABLE OF NON-SIGNIFICANT (MEAN) (MEAN)

DIFFERENT OF	DIFFERENT	LSD
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There are significant different in all fraction tested.

Statistical analysis of variance of polyphenol oxidase
in various fraction of rubber clone GT 1

SOURCE OF VARIATION	DF	SS	MS	F
AMONG GROUPS	2	7.1414138+10	3.5707138+10	32.35316
WITHIN GROUPS	9	9.3323973+09	1.035852+09	
TOTAL	11	1.647138+10		

TREATMENT	MEAN	STANDARD DEVIATION
RUBBER	47240.85	48355.770
SERUM	4144080.15	484820.320
LIGNOIDS	408224.75	413.48.352

$F_{.05}$ - value from table at 2,9 df. is 4.26

reject $H_0 : \mu_1 = \mu_2 = \mu_3$

F - VALUE FROM TABLE AT 9 DF. IS 1.4001

TABLE OF NON-SIGNIFICANT (MEAN1=MEAN2) :

DIFFERENT OF	DIFFERENT	LSD
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There are significant different in all fraction tested.

Statistical analysis of variance of polyphenol oxidase in
various fraction of rubber clone PB 5/51

SOURCE OF VARIATION	DF	SS	MS	F
AMONG GROUPS	2	4.712474E+10	2.356237E+10	2.455227
WITHIN GROUPS	9	3.837009E+10	4.263343E+09	
TOTAL	11	8.549483E+10		

TREATMENT	MEAN	STANDARD DEVIATION
RUBBER	40581.50	33046.100
SERUM	4138782.75	4115784.477
OUTGIDS	4100118.50	4100851.000

$F_{.95}$ value from table at 2,9 df. is 4.26

accept $H_0 : \mu_1 = \mu_2 = \mu_3$

Appendix 4 Cure characteristics of extracted rubber from 3 clones

Cure characteristics	Clone					
	RRIM 600		GT 1		PB 5/5:	
	Control	-Total lipids	Control	-Total lipids	Control	-Total lipids
ML (n.lb.)	16.5	17.4	14.0	14.7	15.0	17.5
MH (n.lb.)	48.2	46.3	44.1	38.5	43.7	47.5
T _S (min)	1.7	1.6	1.3	1.7	1.5	1.7
T ₉₀ (min)	3.5	3.7	3.8	3.9	3.4	3.6
T ₉₀ -T _S (min)	0.53	0.48	0.45	0.41	0.56	0.53

where ML = minimum torque, MH = maximum torque, T_S = Scorch time,

T₉₀ = cure time, T_S-T₉₀ = cure rate

Appendix 5 Cure characteristics of tocotrienol-added rubber from 3 clones

Cure characteristics	Clone					
	RRIM 500		GT 1		PB 5/51	
	Control	+Toco-trienol	Control	+Toco-trienol	Control	+Toco-trienol
ML (in.lb.)	16.6	13.3	14.0	13.9	15.0	14.5
MH (in.lb.)	48.2	46.0	44.1	40.6	43.7	42.3
T _s (min)	1.7	1.5	1.8	1.7	1.5	1.3
T ₉₀ (min)	3.6	3.6	3.3	3.7	3.4	3.7
T ₉₀ -T _s (min)	0.53	0.53	0.45	0.44	0.56	0.50

where ML = minimum torque, MH = maximum torque, T_s = Scorch time,
T₉₀ = cure time, T_s-T₉₀ = cure rate

Appendix 6 Cure characteristics of carotenoid-added rubber from 3 clones

Cure characteristics	Clone					
	RRIM 500		GT 1		PB 5/51	
	Control	+Caro- tenoids	Control	+Caro- tenoids	Control	+Caro- tenoids
ML (in.lb.)	16.5	13.7	14.0	15.3	15.0	15.7
MH (in.lb.)	48.2	43.5	44.1	39.3	43.7	45.9
T _S (min)	1.7	1.5	1.8	1.7	1.5	1.7
T ₉₀ (min)	3.5	3.5	3.8	3.5	3.4	3.5
T ₉₀ -T _S (min)	0.53	0.60	0.45	0.38	0.56	0.57

where ML = minimum torque, MH = maximum torque, T_S = Scorch time,
T₉₀ = cure time, T_S-T₉₀ = cure rate

Appendix 7 Cure characteristics of polyphenol-added rubber from 3 clones

Cure characteristics	Clone					
	RRIM 600		GT 1		PB 5/51	
	Control	+Poly-phenols	Control	+Poly-phenols	Control	+Poly-phenols
ML (in.lb.)	16.5	15.3	14.0	15.7	15.0	14.3
MH (in.lb.)	48.2	45.6	44.1	43.3	43.7	44.1
T _S (min)	1.7	1.7	1.8	1.8	1.5	1.3
T ₉₀ (min)	3.6	3.6	3.3	3.5	3.4	3.5
T ₉₀ -T _S (min)	0.53	0.55	0.45	0.45	0.56	0.51

where ML = minimum torque, MH = maximum torque, T_S = Scorch time,

T₉₀ = cure time, T_S-T₉₀ = cure rate

Appendix 8 Cure characteristics of PPO-added rubber from 3 clones

Cure characteristics		Clone								
		RRIM 600			GT 1			PB 5/51		
		A	B	C	A	B	C	A	B	C
ML	(in. lb.)	16.6	17.1	15.5	14.0	15.0	14.2	15.0	17.6	17.5
MH	(in. lb.)	48.2	43.5	40.9	44.1	38.5	34.7	43.7	43.7	40.0
T _S	(min)	1.7	1.5	1.7	1.8	1.6	1.6	1.5	1.7	1.6
T ₉₀	(min)	3.6	2.9	3.2	3.8	2.9	2.7	3.4	3.0	2.3
T ₉₀ -T _S	(min)	0.53	0.56	0.41	0.45	0.50	0.35	0.56	0.57	0.49

where A = control untreated rubber

B = 0.08 M Tris-HCl buffer containing 1.0 M sucrose added rubber

C = 0.08 M Tris-HCl buffer containing 1.0 M sucrose and PPO added rubber

Appendix 9 Some physical properties of extracted rubber from 3 rubber clones

Physical test	Clone					
	RRIM 600		GT 1		PS 5/51	
	Control	-Total lipids	Control	-Total lipids	Control	-Total lipids
300 % Modulus (kg/cm ²)	20.4 ± 2.0	20.5±0.8	16.7 ± 1.2	22.3 ± 4.0	17.0± 1.5	19.5± 1.1
Elongation at break (%)	734 ± 37	626 ± 20	752 ± 24	627 ± 36	747 ± 22	705 ± 36
Tensile strength (kg/cm ²)	144 ± 20	36 ± 3	106 ± 11	30 ± 9	132 ± 19	102 ± 16
Tear strength (kg/cm)	51.0 ± 5.5	22.0± 1.5	23.0 ± 3.5	19.5 ± 3.3	50.7± 5.7	24.0± 2.5
Hardness(type A)	55	56	55	55	55	55
Specific gravity	1.14	1.12	1.13	1.15	1.13	1.13

Appendix 10 Some physical properties of tocotrienols rubber from 3 rubber clones

Physical test	Clone					
	RRIM 600		GT 1		PB 5/51	
	Control	+Toco- trienol	Control	+Toco- trienol	Control	-Toco- trienol
300 % Modulus (kg/cm ²)	20.4 ± 2.0	19.4±1.1	16.7 ± 1.2	16.2 ± 0.7	17.0± 1.5	13.9± 4.9
Elongation at break (%)	734 ± 37	707 ± 25	762 ± 24	725 ± 18	747 ± 22	773 ± 43
Tensile strength (kg/cm ²)	144 ± 20	114 ± 21	106 ± 11	32 ± 9	132 ± 19	33± 34
Tear strength (kg/cm)	51.0 ± 6.5	24.1± 3.1	23.0 ± 3.5	19.3 ± 2.7	50.7± 6.7	29.3± 2.7
Hardness(type A)	55	56	55	55	55	55
Specific gravity	1.14	1.12	1.13	1.15	1.13	1.12

Appendix 11 Some physical properties of carotenoid-added rubber from
3 rubber clones

Physical test	Clone					
	RRIM 500		GT 1		PB 5/51	
	Control	+Caro- tenoids	Control	+Caro- tenoids	Control	-Caro- tenoids
300 % Modulus (kg/cm ²)	20.4 ± 2.0	18.5±1.5	16.7 ± 1.2	15.5 ± 0.3	17.0± 1.6	16.3± 0.7
Elongation at break (%)	734 ± 37	695 ± 34	762 ± 24	723 ± 25	747 ± 22	752 ± 44
Tensile strength (kg/cm ²)	144 ± 20	108 ± 19	106 ± 11	83 ± 12	132 ± 19	110± 16
Tear strength (kg/cm)	51.0 ± 6.5	31.3± 12.2	23.0 ± 3.5	20 ± 2.6	50.7± 6.7	25.3± 2.5
Hardness(type A)	55	53	55	55	55	56
Specific gravity	1.14	1.12	1.13	1.15	1.13	1.13

Appendix 12 Some physical properties of polyphenol-added rubber from
3 rubber clones

Physical test	Clone					
	RRIM 500		GT 1		PB 5/51	
	Control	+Polyphenol	Control	+Polyphenol	Control	+Polyphenol
300 % Modulus (kg/cm ²)	20.4 ± 2.0	20.1±1.4	16.7 ± 1.2	15.7 ± 1.2	17.0± 1.5	15.5± 5.5
Elongation at break (%)	734 ± 37	571 ± 32	762 ± 24	767 ± 32	747 ± 22	763 ± 31
Tensile strength (kg/cm ²)	144 ± 20	115 ± 15	106 ± 11	37 ± 12	132 ± 19	34 ± 50
Tear strength (kg/cm)	51.0 ± 5.5	26.8± 5.0	23.0 ± 3.5	20.9 ± 1.8	50.7± 5.7	24.2± 4.9
Hardness(type A)	55	56	55	56	55	56
Specific gravity	1.14	1.14	1.13	1.11	1.13	1.15

Appendix 13 Some physical properties of vulcanizate before and after addition of PPO

Cure characteristics	Clone								
	RIM 500			GT 1			PB 5/51		
	A	B	C	A	B	C	A	B	C
300 % Modulus (kg/cm ²)	20.4±2.0	13.0±2.4	13.3±2.5	16.7±1.2	17.0±2.3	12.4±1.7	17.0±1.9	13.3±1.7	12.0±4.5
Elongation at break (%)	734 ± 37	700 ± 94	700 ± 94	762 ± 24	735 ± 33	665 ± 54	747	749 ±	747 ± 23
Tensile strength (kg/cm ²)	144 ± 20	160 ± 26	100 ± 33	105 ± 11	115 ± 14	84 ± 11	102 ± 13	113 ± 21	82 ± 34
Tear strength (kg/cm)	51.0±5.5	51.3±3.5	13.0±1.5	23.0±3.5	26.6±2.5	19.3±2.5	50.7±5.7	33.1±2.7	21.2±5.0
Hardness (byce A)	55	55	53	55	55	55	55	54	54
Specific gravity	1.14	1.15	1.13	1.13	1.15	1.14	1.13	1.15	1.14

where A = control untreated rubber

B = 0.08 M Tris-HCl buffer containing 1.0 M sucrose added rubber

C = 0.08 M Tris-HCl buffer containing 1.0 M sucrose and PPO added rubber

BIOGRAPHY

Mr. Kittinan Komolpis was born on March 15, 1968. He conferred his Bachelor degree of Science in Biochemistry from Chulalongkorn University in 1989 and continued his study in Master program at the department with the fellowship awarded by the Science and Technology Development Board (STDB) in 1989-1991.

